Machinery Fault Diagnosis Based on Domain Adaptation to Bridge the Gap Between Simulation and Measured Signals

Abstract

In intelligent fault diagnosis, the success of artificial intelligence (AI) models is highly dependent on labeled training samples, which may not be obtained in real-world applications. Recently, a finite element method (FEM) simulation-based personalized diagnosis method was developed to overcome the problems of insufficient and incomplete labeled training samples. However, the simulation signals obtained using the FEM and measured signals actually have a certain deviation. To supplement the FEM simulation-based personalized diagnosis method, a fault diagnosis method using domain adaptation (DA) is proposed to bridge the gap between simulation signals and measured signals. First, the FEM is adopted to obtain sufficient and complete simulation samples of all the fault categories as the original fault samples in the source domain. Second, the original simulation fault samples are adjusted using a generative adversarial network (GAN)-based DA network to make them similar to the measured samples through the adversarial training of the refiner and domain discriminator. Last, credible adjustment fault samples and measured fault samples obtained in machinery are applied to a convolutional neural network (CNN) for training and testing to complete the fault classification. The data obtained from rolling element bearing and gear test rigs are utilized to explore the feasibility of the proposed method, and the classification accuracies reach 99.44% and 99.58%, respectively. The comparison investigations using experimental data of gears and bearings indicate that the present method can accurately classify faults in machinery.